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AARI
Alberta Agricultural
Research Institute

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2004 • VOLUME IV • ISSUE 2 WE BELIEVE IN GROWING ALBERTA'S ECONOMY

Global Research on BSE

The serious and mysterious disease of BSE has recently devastated the Canadian cattle industry, especially in the West. This disease, as well as other TSEs, has been actively researched for nearly 20 years on three continents. Much headway into understanding BSE has been made, but even after years of hard work and billions of dollars invested, this disease is proving to be a formidable opponent with no quick or easy solution.

Bovine spongiform encephalopathy (BSE), or mad cow disease, was first discovered in 1986 in the United Kingdom. The disease originated in the UK, most likely transmitted through the feeding of bovine material, such as brain and spinal cord, back to cattle. Though the place origin of BSE is known, science has yet to determine exactly how the causal agent came to infect the original cattle. Some speculate that the disease occurred spontaneously; others believe it may have originated from scrapie-infected sheep parts being fed to cattle, scrapie being a related disease of BSE, which falls into the larger transmissible spongiform encephalopathy (TSE) family.

One thing scientists can agree on is the effect BSE has on an infected animal: cattle become aggressive or nervous, produce less milk, lose weight while still eating normally, lose coordination or may lose the ability to rise or walk. Internally, lesions appear on the brain and spinal cord of cattle, creating tiny holes in the brain and spinal cord, making them look like a "sponge" – hence the name spongiform. The disease is fatal two weeks to six months after the onset of symptoms.

What scientists are less certain about is the causal agent of the disease. Two theories abound, both supported by scientific evidence, though neither is fully understood. The most widely-accepted belief is that BSE is caused by a mis-folded prion (PrP^{sc}) – a self-replicating collection of proteins. Others believe the agent is like a virus, carrying genetic information. This second theory explains how BSE can form varying strains, but isn't as widely supported by scientific evidence.

> Considered a key element for eradicating BSE, work into developing efficient, cost-effective ante-mortem diagnostics has been a priority in both public and private laboratories.

The Prion Puzzle

Understanding normal prions and their function in mammals and in TSEs is a crucial first step in combating BSE. Though work filling the knowledge gaps related to prion structure, replication, and the role of normal prion proteins has been going on for some time, progress is impeded by the scarcity of laboratories meeting biohazard and bioterrorism criteria, limited access and supplies of infected tissues, and the lengthy period required to yield results.

Preliminary studies, however, have shown that the immune response to prions is absent, the pathways from ingestion to infectivity may or may not be affected by numerous factors, and that host susceptibility is highly variable. Prions have been found in a variety of structures in cattle, such as the spinal cord, tonsils, brain, and nerve ganglia, but never in the muscle tissues or blood.

There have also been documented cases of genetic susceptibility or resistance in animals to scrapie, chronic wasting disease, and variant Creutzfeld-Jacob disease (vCJD), however the routes of transmission and host susceptibility of BSE lacks full understanding. There has been no documented natural resistance to BSE in cattle to date.

Diagnosis is Key

Considered a key element for eradicating BSE, work into developing efficient, cost-effective ante-mortem diagnostics has been a priority in both public and private laboratories. Again, advances

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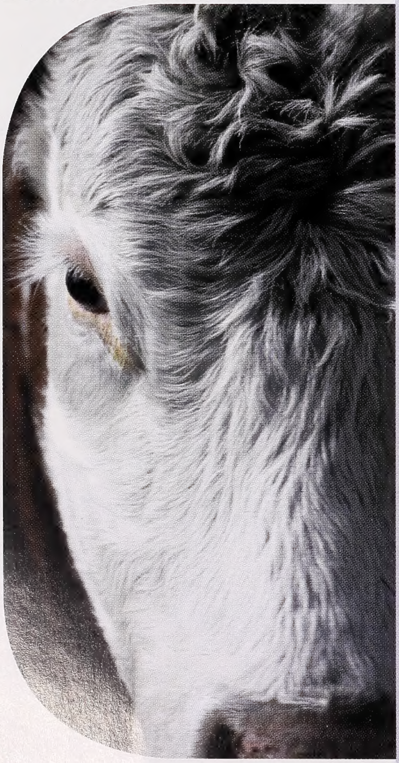

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in diagnostic approaches beyond current post-mortem tests hinge on fully understanding the prion structure, function, replication, and mis-folding. Over 100 institutions are currently working towards developing a means to diagnose the disease in live animals. The EU and U.S. have taken the lead on this piece of the BSE puzzle, using novel technologies such as micro-filtration, surrogate markers, and PCR (polymerase chain reaction) techniques, but the largest roadblock in developing this test is the lack of available infected tissue.

Tracking the Infection Route

Feed source infectivity has been identified as the key route of infection of BSE, and cattle born before the 1997 meat and bone meal (MBM) feed ban pose the highest risk for BSE. The challenge of tracking where the disease came from and where it has gone is compounded by most cattle being slaughtered at a young age, long before any disease symptoms would manifest themselves. Since every animal was not tested for the disease, it is possible that infected animals, originating from the UK, were introduced into Canada's feed supply prior to 1997. Mass application of post-mortem screening would determine the existence of any infected animals but is incredibly costly. A research priority right now is to develop and conduct risk assessment studies to formulate mitigation measures and disease management strategies. There is also a need for on-farm testing and sampling of expired animals for all TSEs.

The control measures that have been implemented over time are working, and according to a Harvard Study, the eradication of BSE in the U.S. will happen over a maximum 20-year period with the complete elimination of contaminated feed.

The Road Ahead

Much attention has been paid to the various avenues of controlling, preventing, treating, and eradicating BSE. Despite this, there are no known successful treatments for any TSE, and only treatment as it relates to humans (vCJD) will be pursued. Some evidence suggests that the development of genetically resistant animals is possible (accomplished in mice and elk for chronic wasting disease), and preliminary work in Asia indicates there are possibilities for transgenic developments in cattle.

The control measures that have been implemented over time are working, and according to a Harvard Study, the eradication of BSE in the U.S. will happen over a maximum 20-year period with the complete elimination of contaminated feed. There is, however, currently no vaccine, and the priority now is to completely eliminate exposure of animals and people to infectious agents of TSEs. Research is seeking to develop an efficient and effective means of detecting prion infectivity in food and feed distribution systems.

Ensuring the prion structure is completely destroyed, if and when an infected animal is found, is an important part of these control measures. In order to ensure deactivation of the causal agent after or during research, the Canadian Food Inspection Agency and its counterparts in the EU and U.S. have established standards for decontamination of equipment and laboratory facilities. Further work is being done to explore inactivation of prions under alkaline hydrolysis and high temperature incineration, though prions are proving to be resistant to destruction. What has yet to be determined is how to remove infectivity from MBM and/or animal products. Investigation continues into enzymatic treatment of facilities and instruments, ultimately in hopes of applying the technology to management of MBM, carcasses, and the farm environment, i.e. composting.

BSE is proving a complex and intricate riddle yet to be unravelled. The science involved in combating the disease is intricate, ground-breaking, and time and fund consuming. There is no quick fix, but global research is focusing on epidemiology, surveillance, and diagnostics of the disease in order to eradicate it once and for all.

Renewal Project List

Ongoing projects funded by AARI and the Funding Consortium

Project Title	**Project Manager**
Integrated Management of Cabbage Seed Pod Weevil in Canola	Dr. Lloyd Dosdall
Irrigating Cropping Systems for Sustainable Management	Dr. Frank Larney
Improving Agronomic Traits of Legumes and Creating Value-Added Legume Products	Dr. Jocelyn Ozga
Chickpea and Lentil Cultivar Development for Alberta	Dr. Tom Warkentin
Integrated Control of Rhizoctonia Root Rot of Pulses	Dr. Sheau-Fang Hwang
The Use of Milk Epidermal Growth Factor to Control Cryptosporidiosis in Cattle	Dr. Andre Buret
Kura Clover (*T.Ambiguum*) Seed Production and Weed Control	Dr. Jane King
Commercialization of Net Feed Efficiency for Beef	Dr. John Basarab
Introgression and Molecular Characteristics of Multiple Disease Resistance Traits from *Brassica Carinata* Into *B. Napus* in Alberta	Dr. Habibur Rahman
Integrated Crop Management of Blackcurrents in Alberta	Dr. Kenneth Fry
Assisted Reproductive Technology in Horses	Dr. Claire Card
Development of Modified-Atmosphere Packaging to Maintain Fresh Saskatoon Fruit Flavour and Quality	Dr. Wendy Wismer
Swine Reproduction and Development Program	Dr. George Foxcroft
Barley Fractionation – Investigating Protein and Pentosan Fractions	Dr. Feral Temelli
Strategic Approaches to Reduce Phosphorus and Nitrogen Pollution Resulting from Swine Production	Dr. Willem Sauer
Livestock Odour Control Technology Assessment and Development	Mr. Ike Edeogu
Development of a Scientific Siting Tool and Odour Monitoring Procedures for Alberta Livestock Operations	Dr. John Feddes
CLA-Enriched Meat and Milk Product Development	Dr. Erasmus Okine
Spring Wheat Development: A Collaborative Program for Alberta	Dr. Dean Spaner
Managed Pasture Systems that Reduce Risk	Dr. Vern Baron
Biodegradable Polymers from Alberta Oilseeds: Fundamental Science Pilot-Scale Development, Economic Feasibility and Market Analysis	Dr. Suresh Narine
Application Research for Barley/Oat Grain Components that are Produced by the Fractionation of those Grains Using a New/Novel Patented Technology	Dr. Thava Vasanthan
The Bovine Genome Project	Dr. Stephen Moore
Risk of Bluetongue Transmission in Western Canada Following Importation of U.S. Feeder Cattle	Dr. Tim Lysyk
Gene Flow in Rumen Bacteria and its Implications for GM Foods	Dr. Tim McAllister
Vaccination Strategies to Enhance Immunity in Bovine Mammary Gland	Dr. Andy Potter
Disease Resistance in *Brassica napus* Canola: Proteomics-based Investigation	Dr. Nat Kav
Barley Resistance Mechanisms to Fusarium Head Blight	Dr. Keguan Xi
Monocots Transgenesis via Single-stranded T-DNA Complex Delivery to Pollen	Dr. Ivor Kovalchuk
Economic and Welfare Comparison of Three Different Group Housing Systems for Gestating Sows	Dr. John Church
Cost-effective Feeding of Farmed Deer	Dr. Robert Hudson
Improved Genetic Resistance to Mycosphaerella Blight of Field Pea	Dr. Sheau-Fang Hwang
Identification of Early Indicators of Metabolic and Reproductive Dysfunction from Over-feeding Female Broiler Breeders	Dr. Frank Robinson
Commercial Supercritical Fluid Extraction of Canola to Produce Higher Valued Oil and Meal	Dr. Feral Temelli
Assessing the Consumer Acceptance and Market Potential of Alternative Meats	Dr. Kevin Chen
Rapid Determination of Broiler Amino Acid Requirements and Amino Acid and Energy Availability of Feedstuffs	Dr. Doug Korver
Conventional and Chemical-free Control of Potato Late Blight and Colorado Potato Beetle	Dr. Qin Chen
Development of Neonatal Immunization Strategies Against Bovines Respiratory Disease Using CpG Motifs as Adjuvants	Dr. Sylvia vanDrunen Little-van den Hurk
Development of Prebiotics, Probiotics, and Synbiotics – Containing Functional Foods for the Management of Inflammatory Bowel Disease	Dr. Lech Ozimek
Disease Fighting Nutraceuticals from Stress Induced Native Plants	Dr. Kevin Smith
Bovine Genome Annotation through cDNA Sequence	Dr. Stephen Moore
First Generation Linkage Disequilibrium Maps of Bovine Chromosomes 14 and 19	Dr. Stephen Moore
Monitoring and Controlling Fusarium Wilt of Canola	Dr. Ralph Lange
Agri-fibre Pulp Initiative	Mr. Ian Murray
Biomass Production Research for the Development of Biomaterial the Pulp and Building Industries in Alberta	Dr. Kwesi Ampong-Nyarko
Properties of Refined Wood and Non-Wood Chemical Pulps and their Papermaking Potential	Mr. Wade Chute
Optimization of Kraft Pulping for Agri-fibres	Dr. Shijie Liu

There are also several confidential projects that cannot be identified in this list.

New R&D Projects Funded by AARI

Highlights of a Few New Projects funded by the Funding Consortium

Near Infrared Reflectance Spectroscopy (NIRS) within a Grain Classification, Valuation, and Quality Determination Platform

Dr. James Helm, Alberta Agriculture, Food and Rural Development

Feed grain, whether it's a load of barley, wheat, or corn, is priced relatively the same from farm to farm or mill to mill, but the nutritional content varies tonne by tonne. Until now there hasn't been an inexpensive, rapid way of assessing the energy, protein, fibre, and palatability of a feed grain, except through lengthy and costly feeding trials or laboratory analysis. The technology using Near Infrared Reflectance Spectroscopy (NIRS) has now been developed to scan a sample of grain for just such feeding characteristics – and it can do so in less than a minute. This project seeks to commercialize the NIRS technology so that every farmer selling grain and every livestock farmer purchasing the product can make a more informed (and cost-effective) choice of their feedstock.

FHB Mycotoxin Detoxification and Increased Resistance to Initial Infection in Wheat and Barley

Dr. Francois Eudes
Agriculture and Agri-Food Canada

Fusarium head blight (FHB) is a devastating and economically important fungal disease that reduces the quality and yield of crops like wheat, barley, and oats. Dr. Francois Eudes' project aims to determine how wheat and barley plants are able to detoxify or tolerate the mycotoxin produced by the FHB fungus. Eudes' approach to developing resistant cultivars is tri-fold: protein identification, which will allow the development of molecular markers that will confer the ability to detoxify or tolerate higher levels of mycotoxins; pro-biotics – the insertion of very small proteins that disturb the membrane of the harmful fungi killing or slowing their growth; and transgenesis, an approach that relies on enzymes that degrade the fungus cell wall or attack and partially digest its membrane. His work will generate tools that will enable breeders to develop resistant cultivars more rapidly and address producers' needs for a more competitive crop.

Relationship of Embryonic Yolk Absorption to Clubbed Down, Poor Chick Quality, and Reduced Broiler Uniformity

Dr. Gaylene Fasenko
University of Alberta

Clubbed down is a feathering abnormality of newly hatched chicks which occurs in some provinces at a rate of 10 per cent. The "club-like" appearance of feathers occurs primarily on the

and the Funding Consortium

chest and abdomen. Preliminary research at the University of Alberta has shown that these chicks are smaller than average and have larger residual yolk sacs at hatching. Chicks that are identified in the hatchery as having clubbed down create an inefficiency in the broiler production chain; these chicks are culled and do not get shipped to broiler farms. The goal of Dr. Gaylene Fasenko's project is to try to identify the cause of clubbed down. The hypothesis is that chicks develop clubbed down because they are not able to properly metabolize nutrients from the yolk. The results of this research may also be used to tackle other questions regarding chick quality and health.

Development of Novel Screening Methods for Seed Dormancy in Barley

Dr. Jennifer Zantinge

Alberta Agriculture, Food and Rural Development

Barley sprouting soon after harvest is a good thing for Canada's malting industry, but barley sprouting in the swath, bin, or ocean-faring shipping vessel while on its way to maltsters, can mean lost quality and value for farmers and maltsters. Very little seed dormancy exists in current barley varieties, a problem that Dr. Jennifer Zantinge's work seeks to understand and then address. First, the project plans to develop dormancy indices for current barley varieties. In phase two, the goal is to track down a molecular marker for seed dormancy, which will help barley breeders develop varieties with enhanced seed dormancy and keep Canada's overseas barley customers happy.

Proposal Title	Team Leader	Organization	Total Amount Funded	
Molecular Enhancement of Seed Oil Production in a Modern Breeding Line of Canola under Field Conditions	Dr. Randall Weselake	U of Lethbridge	$997,202 over 4 years	
The Impact of Timing of Protein Intake and Growth Patterns on Reproductive Efficiency in Broiler Breeder Females	Dr. Frank Robinson	U of Alberta	$90,000 over 2 years	
Plant Made Pharmaceuticals: Achieving the Promise, Limiting the Risks	Dr. Michele Veeman	U of Alberta	$195,500 over 2 years	
Development of Novel Screening Methods for Seed Dormancy in Barley	Dr. Jennifer Zantinge	Alberta Agriculture, Food and Rural Development	$150,000 over 3 years	
Near Infrared Reflectance Spectroscopy (NIRS) within a Grain Classification, Valuation, and Quality Determination Platform	Dr. James Helm	Alberta Agriculture, Food and Rural Development	$700,000 over 3 years	
FHB Mycotoxin Detoxification and Increased Resistance to Initial Infection in Wheat and Barley	Dr. Francois Eudes	Agriculture and Agri-Food Canada	$423,280 over 5 years	
Relationship of Embryonic Yolk Absorption to Clubbed Down, Poor Chick Quality, and Reduced Broiler Uniformity	Dr. Gaylene Fasenko	U of Alberta	$53,734 over 2 years	
Synergism of Phytase and Xylanase Addition to Finisher Pig Diets	Dr. Ron Ball	U of Alberta	$67,070 over 2 years	
Improving Dairy Herd Fertility: An Objective Assessment of Reproductive Efficiency - A Benchmark Study	Dr. Divakar Ambrose	Alberta Agriculture, Food and Rural Development	$102,000 over 2 years	
Poultry Meat Scientist	Mr. Lloyd Johnson	Alberta Chicken Producers	$500,000 over 5 years	
			$3,278,786	Total Amount Funded
			$1,693,377 (52%)	AARI's Portion

A Pulsing Network

If those passionate about pulses had their way, every grain farmer in the province would be including a pulse crop in their rotation. Though this isn't yet the case, the pulse industry in Alberta is growing steadily, thanks to a strong network of producers and researchers working hand in hand to ensure the priorities in the field are addressed in the lab.

As Executive Director of the Alberta Pulse Growers (APG), Janette McDonald is the principal liaison between the pulse industry, researchers, and producers. She says while market development is always a priority, supporting research and generating results producers can apply to their fields is the most pressing goal. "We are putting huge emphasis on extension and getting better, more accurate, more timely information to our farmers in a medium that they can pick up and respond to more quickly," she says.

Fighting diseases such as ascochyta blight, powdery mildew, and mycosphaerella blight is the priority, but finding better crop protection strategies in beans, and knowing and exploiting the rotational benefits of field peas also needs to be addressed. "Peas fit so well in a direct-seeded crop rotation," says McDonald. "We need to explore good integrated management practices that take advantage of what peas can accomplish (i.e. nitrogen fixation). This includes improving our knowledge of disease, weed, and soil management as they relate to pulses." Farmers, she explains, want to understand the dynamics of the whole picture so they can be more environmentally sustainable, more profitable, and better manage their soil over the long-term.

> "Working directly with the farmers is a win-win situation. I can generate results that have value in the real world by providing a scientific basis for actions the producers can take to improve their crop yield."
>
> – Dr. Sheau-Fang Hwang
> Alberta Research Council

Like AARI, APG works closely with scientists to ensure farmers' needs are addressed through research. "We are constantly improving the network so that researchers understand what farmers need, especially because we don't have a huge acreage in Alberta," says McDonald. "We think that every grain farmer in this province should be growing a pulse crop, but the challenge is to get them that information that proves the long-term benefits of including pulses in their rotation."

Dr. Sheau-Fang Hwang remembers the early '90s when the pulse industry was starting to take off. Farmers then didn't realize that a brown-purple colour canopy was an indication the crop was struck with mycosphaerella blight. Similarly, Hwang had to show farmers seeds covered with white mycelium and seedlings pulled from the ground with rotten and diseased roots in order to convince them that seedling blight was a serious problem in the province. The industry, she says, has come a long way since then. With the growing network and exchange of information and expertise in pulses, most farmers are very familiar with the signs of both types of blight and know what to look for.

Currently, Hwang is the Senior Research Scientist at the Alberta Research Council in Vegreville focusing on root-rot and foliar diseases of field peas, lentils, and chickpeas. She is working on the development of a yield-loss model for mycosphaerella blight in field peas so that growers will know at what threshold it is economical to spray fungicide. With funding from AARI, she is also working to improve genetic resistance to the disease through breeding.

Hwang initiates a disease survey every three years to identify issues Alberta pulse

> "As a scientist, we have to be able to see what other people can't and then educate them as best we can."
>
> – Dr. Kan-Fa Chang, Alberta Agriculture, Food and Rural Development

growers are facing. The survey benefits both the farmers and Hwang who uses their diseased plant samples in her lab to isolate the harmful pathogens. She has direct contact with growers through her attendance at extension presentations and demonstration sites where she holds a variety of workshops to present her findings on a field-size scale. Hwang also participates in the Alberta Agriculture, Food and Rural Development's Disease Diagnosis Schools where farmers can come and see for themselves how different chemical treatments work.

"It is important to work directly with the growers because they can identify their particular issues," she explains. "Quite often, I design my research projects around the questions they are asking." For example, a study she conducted on the effects of seed damage was in response to a question raised by farmers as to why seed treatments were doing little to increase their yields. Hwang's research found that seed treatments help with germination, but any mechanical damage from over-winter storage or harvest where seed coats are cracked will cause vital nutrients to leak out, resulting in a seedling with poor vigour and a crop with poor yields.

Now, as a result of her work and others', most farmers perform seedling vigour and germination tests prior to planting; modifications to combining equipment have helped to reduce mechanical damage to the seeds at harvest. "Working directly with the farmers is a win-win situation," she says. "I can generate results that have value in the real world by providing a scientific basis for actions the producers can take to improve their crop yield."

Gordon Tuck, Past President of APG's Extension Committee, has seen a lot of change over the 14 years that he's been growing pulses. From a time when there was very little information, there are now grower manuals as well as videos available on seeding, handling, and harvesting peas and chickpeas. There is also an impressive network of technology transfer media including the web-based Pulse Agronomy Network; APG's journal, Pulse Crop News; a Farm Tech Program, where speakers like Hwang present the results of their research; and, "Back to the Farm", a new extension program designed to encourage farmers to go out and do applied research for themselves.

Dr. Kan-Fa Chang, long-time pulse crop pathologist with the province who also happens to be the husband of Dr. Hwang, is currently working at the Crop Development Centre at Lacombe on the joint Alberta-Canada project to launch a new pea-breeding program – which is extremely good news for Alberta's pulse crop industry. "In breeding programs, we tend to over-emphasize yield and not consider disease resistance," he explains. "Finding sources of disease resistance takes much longer than the yield breeding programs but is more economically important."

Chang recalls a grower last year whose entire pea crop turned snow white with mycelium from a powdery mildew fungus, losing him over $100,000. It was the most severe outbreak Chang has ever seen. He notes the crop might have been saved had the disease not gone undetected by a number of field scouts. This highlights the need, he says, for more training so that agronomists and farmers alike can better detect pulse diseases before they result in dramatic losses.

Chang and Hwang are just two of a number of researchers taking direction from growers to address the priorities in pulse crop research in the province, and like the rest they take their roles very seriously in helping farmers like Tuck succeed. "As scientists, we have to be able to see what other people can't and then educate them as best we can," says Chang. With such a team-focused perspective, it is easy to see why Alberta's pulse network is so strong.

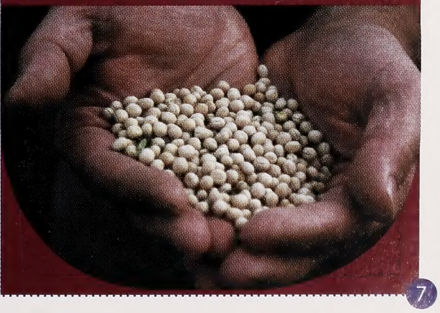
DID YOU KNOW...

- In Alberta, there are roughly 4,000 pulse producers growing:
  - 50,000 acres of dry beans in irrigation country (Southern Alberta) where the majority are pintos, blacks, red, and pinks all of which are exported – mostly to the U.S.
  - 600,000 acres of dry peas – predominately yellow – 60% of which are exported and 40% of which are fed domestically
  - 25,000 acres of lentils and chickpeas

- Beans have been around for a long, long time. The Anasazi bean, a close cousin to the popular pinto bean was unknown until ancient beans were found in the Anasazi ruins in the Southwest U.S. Despite their age – the Anasazi disappeared over a thousand years ago – these beans germinated and grew, giving life to new generations of this ancient bean.

- Lentils are used almost exclusively for food. Generally they are canned or packaged, whole or split, for retail sale, or processed into flour. They are then used in soups, stews, salads, casseroles, snack food, baking and vegetarian dishes. Lentils are often used as a meat extender or substitute because of the high protein content and quality.

- Beans come in a multitude of varieties. Common beans include pinto, kidney, red, great northern, white, lima, black, and navy. Less commonly known beans include cranberry, cannelloni, fava, and Anasazi.



A Dynamic Duo

Drs. Igor and Olga Kovalchuk first accepted concurrent job offers from the University of Lethbridge for the convenience of being able to pursue their research interests in the same place. The couple has very quickly found, though, it was a smart choice, thanks to a supportive environment for their work and the opportunity to make a real difference to plant science in Alberta.

Drs. Olga and Igor Kovalchuk

The University of Lethbridge may not have been their first choice but as these researchers from the Ukraine have discovered, the city of Lethbridge and its vibrant, close-knit campus are the perfect setting in which to make great scientific gains that could benefit consumers and farmers in a big way.

Igor and Olga Kovalchuk met in the Ukraine prior to medical school. While he completed his M.D. in gynecology, she pursued dentistry. It was a shared interest in plant science and the crossover potential for human biology, however, that led them to make a radical career switch and submit a joint proposal to work on their Ph.D. theses in Switzerland. They were accepted at the Friedrich Miescher Institute for Biomedical Research in Basel, a private institute belonging to Novartis that focuses on using new technologies to explore basic molecular mechanisms of cells and organisms in health and disease. "We started our work as a collaborative research project studying the effects of radioactive contamination on plants and humans caused by the Chernobyl accident," Igor explains. "The project evolved and we went deeper into plant DNA repair and stress responses."

The Kovalchuks worked in Switzerland from 1996 until they came to Lethbridge in July of 2001. "We sent out a lot of applications," says Olga. "Since we work in such closely related fields, it is rare to find two open positions." Lethbridge was the first dual interview they had and, though it was followed by several other interviews, it was decided very quickly that it would be the place to settle. "We are not big-city people," she explains. "We liked Lethbridge for its manageable-sized city and close-knit campus."

Both are assistant professors at the University in the Department of Biological Sciences. Igor studies the influence of various internal and external factors on the genome stability of plants, as well as the various aspects of plant biotechnology in order to develop new or improve existing methods of plant transformation. He works mainly with *Arabidopsis thaliana* (thale cress weed), and tobacco plants, and is extending his work to wheat. It is possible that in the future he will include canola in his research.

> "Institutions like AARI and AVAC are looking for innovative ideas and are willing to take certain risks. Typically, if they feel the proposal is exciting, they will go for it."
>
> – Olga Kovalchuk
> University of Lethbridge

Olga's research involves assessing new plant components derived from plants that may have anti-inflammatory or anti-cancer potencies. "With my medical background as well as my plant background, it was a good crossroad to start looking for beneficial health components that can be extracted from plants," she says. "By screening extracts from various plants growing under both normal and stressed conditions, we are searching for new plant-derived drugs that could be used to fight cancer." She also does research on the harmful effects of radiation on genome stability and links it to her work on plant-derived pharmaceuticals. "I believe that we may also find plant-derived components that could eventually be used to protect people from the harmful effects of radiation."

The Kovalchuks are encouraged by the level of funding support they have received to date. "Institutions like AARI and AVAC are looking for innovative ideas and are willing to take certain risks," says Olga. "Typically, if they feel the proposal is exciting, they will go for it." She feels these funding bodies embrace projects with a future vision and potential long-term benefits. For Olga, her work has enormous potential value for human health and for farmers who may eventually be able to diversify their traditional crops with new, more valuable medicinal plants. One of Igor's current projects involves the analysis of transgenic food safety for consumers, and of course any gains in the knowledge of plant stress will be a boon to producers in the form of more effective crop management strategies.

Here's hoping that this dynamic duo will be thinking long-term about their contribution to science and living in Alberta!

Netting Opportunity

The Aquaculture Centre of Excellence in Lethbridge is casting an ever-widening net of applied fish farming research in order to reel in agricultural diversification opportunities for Alberta producers.

Using silver carp (above) to manage algae in bodies of water is just one of the many projects being pursued by the Aquaculture Centre of Excellence in Lethbridge. Water from the fish tanks is recycled through hydroponically grown plants, also known as aquaponics (right).

"We're doing this work on aquaculture research in the middle of an area that uses irrigation to grow crops. It's a bit of an enigma why you'd have fish farming research in a dry area like this," says Bill Mackay, the Centre's director, acknowledging the raised eyebrows he receives when discussing the facility's viability in arid Southern Alberta. "But the reason you can do it is because we use a very efficient technology – this recirculation technology (that the centre employs)."

Founded 14 years ago by the late Dr. Ron Beck, the facility located at Lethbridge Community College began as a grass carp breeding centre – grass carp being from the Amur River in China and known as the "king of aquatic weed eating fish", according to Mackay. In Alberta, grass carp is now the most effective biological-based control for reducing weed populations in irrigation ditches and in private and municipal ponds, proving an invaluable asset to farmers seeking increased efficiency in their operations without the use of chemicals.

To capitalize on fish farming opportunities over and above this growing demand for grass carp, three organizations – Alberta Agriculture, Food and Rural Development, Lethbridge Community College, and the Alberta Fish Farmers Association – agreed to re-establish the facility as the Aquaculture Centre of Excellence last year. The Centre's mandate is to further the development and promotion of aquaculture as a viable component of the agriculture industry, through applied research and development.

Aided by key funding partners such as the Diversified Livestock Fund of Alberta and AARI, the Centre carries out its mission by initiating leading-edge applied research projects.

Some of the most recent work includes:

Aquaponics

This is an example where the recirculation technology Mackay alluded to has been taken to another level. The secret to the Centre's success is that it utilizes an environmentally sustainable system – virtually all the water from its fish rearing tanks is filtered, treated, and returned to the fish tanks. With aquaponics, which combines aquaculture and hydroponics, the activity of growing plants is added to this system. Water from the tanks is pumped to the trays of plants in the greenhouse, where the plants filter the water by absorbing its nutrients before the water is sent back to the fish again.

Disease

The Centre boasts a PCR laboratory dedicated to conducting molecular work on fish diseases. The lab's primary work is to develop fast tests for common trout diseases – rainbow trout representing "the backbone of inland aquaculture in Western Canada." In fact, the Centre is on the verge of patenting several molecular sequences of DNA for identifying fish disease.

Control of Phytoplankton

The Centre is now in the pre-commercialization phase of its silver carp program, which is a natural extension of its grass carp program, with one major twist: "Silver carp eat algae. Algae is what makes water look like pea soup," says Mackay. "Right now, we're trying to decide how many fish you can put in a pond, how long they'll survive, how well they'll control the algae, that sort of thing." Like grass carp, the silver carp are bred to be sterile, so that as a foreign element introduced into a pond or other body of water, they do not overrun their environment.

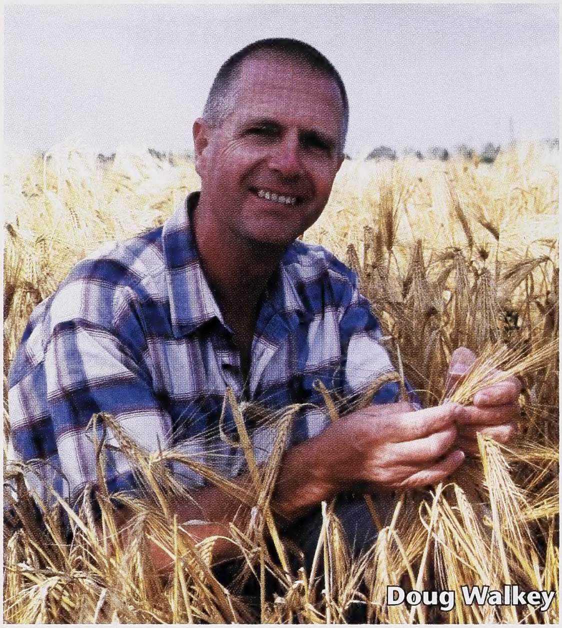
So, what projects are most exciting to Mackay? "Researchers are always excited about the current research – that's the molecular disease work, and also the work with silver carp and phytoplankton," he says. "With grass carp we're into a commercialization phase, so most of the exciting research is already done. Now what we're doing is getting fish farmers involved in growing, using, and selling grass carp as a commercial venture."

Speaking of fish farmers, according to Mackay, most significant Alberta fish farming operations are in barns, not outside. "If you were to drive by, you wouldn't know it was a fish farm because you wouldn't see any water," he says.

However, if the Centre of Excellence has its way, the fish farming industry in Alberta will be a lot more visible than that. And as anyone involved with the Centre will probably tell you, there are always bigger fish to fry. On second thought, better make that fish to grow.

Profiling our Partners – ACIDF

The Alberta Crop Industry Development Fund seeks creative proposals that will keep Alberta's crop industry moving forward. The organization also looks for projects that have a strong market focus and increase the competitiveness of Alberta farmers through such avenues as leadership, research, innovation, training, and marketing initiatives.



Doug Walkey

When investing in new projects, the Alberta Crop Industry Development Fund (ACIDF) considers both tradition and innovation in order to meet the needs of Alberta producers in all areas of crop production. ACIDF, an independent, not-for-profit company operating under the direction of the crop industry, provides resources to increase the competitiveness of Alberta farmers through leadership in industry research, innovation, and marketing initiatives, with a vision for a globally competitive crop industry in Alberta.

ACIDF's focus is divided into five major crop sectors: special crops, horticulture, cereals, oilseed, and forages. All areas, however, are marked by the same strategic goals:

- Increased capability of farmers to manage risk
- Increased value chains, new business, and new markets
- Increased diversification in the crop sector
- Improved crop research capacity
- Increased consumer confidence in food production

"One thing we take very seriously is that ACIDF is really a voice for the producer sector," says Doug Walkey, Executive Director of the organization. "Our mandate and vision is to develop the crop sector specifically in Alberta, and so as a result, producers' priorities are amalgamated into our priorities." Whether through research or simply helping them to develop their own set of strategic goals and plans, ACIDF works closely with its signatories to help those groups succeed with both their short and long-term aspirations.

ACIDF is recognized for its forward-thinking approach to venture. "I've had many different researchers comment that our organization tends to be aggressive and imaginative in how we make investments," says Walkey. "We're being recognized as a value-added organization because we have funded some very high profile projects in the value-added sector." However, he notes that while ACIDF looks for innovation in the projects that it funds, the majority of its investments are in traditional farm-gate areas, including risk management production and agronomy.

Being a part of the Alberta Agriculture Funding Consortium has helped ACIDF to further its goals. "From an industry point of view, the Consortium model is excellent," says Walkey. "The one-window application process is more streamlined, giving ACIDF the ability to pull together larger, more multi-faceted projects." ACIDF is also attracted to the Consortium's equitable process – there's no competition for proposals around the table and no expectation on the various organizations involved to change their policies in order to conform. "By taking part in the Consortium, we can benefit everyone yet still maintain our own mandate to represent the crop sector and our signatories," he says. "Each member of the Consortium can take part in what they feel are the priorities and make appropriate investments."

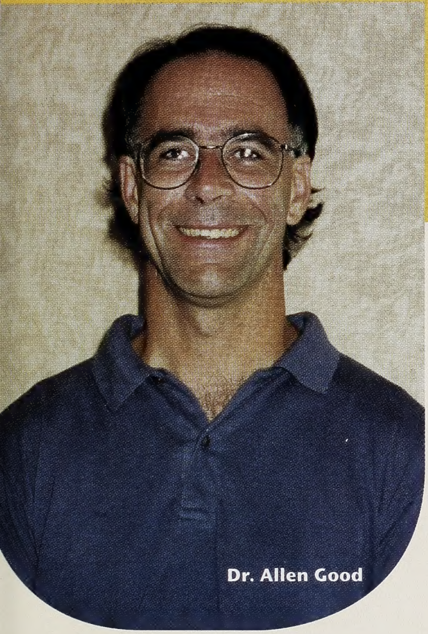
The combined experience and expertise of the Consortium has also helped broaden the scope of ACIDF's own funding perspective. "We like to work closely with the Funding Consortium on proposals that require technical assessment because it has a well-established, standardized technical review process," says Tom Machacek, Secretary Treasurer for ACIDF. "Additionally, when you're dealing with projects, especially in areas that have a long research history, it's difficult to know what's been done and what hasn't. When you sit around the table with the other members of the Consortium, there's a greater chance that someone will have the experience or knowledge that will help you make a better, more sound funding decision."

> "Our mandate and vision is to develop the crop sector specifically in Alberta, and so as a result, producers' priorities are amalgamated into our priorities."
>
> – Doug Walkey, ACDIF

Like all members of the Consortium, ACIDF's overall vision is to move Alberta's agriculture industry forward. Working side by side with producer groups and infused with the Consortium's spirit of collaboration, ACIDF is well-positioned to continue making the province's crop industry prosper both at home and abroad.

Fostering Research Momentum

Blackleg. Flea beetles. Plant diseases. Dr. Allen Good has made considerable contributions to pathogen and insect resistance in canola – AARI's funding support has had a significant impact on his progress.



Dr. Allen Good

Dr. Allen Good of the University of Alberta, Department of Biological Sciences, has been working since 1989 to assess how plants adapt to environmental stresses such as flooding and drought. Good and his team have cloned and characterized several genes that protect plants from these stresses. However, his interest goes beyond, into the mapping of genes in canola that confer resistance to pathogens and insects such as blackleg and flea beetle. He has found that several species of wild *Brassica* harbour effective forms of resistance to these pests and, in collaboration with Dr. Gary Stringam, has been working diligently to transfer those novel sources of resistance into germplasm Western Canadian breeders can use.

In sync with the integrated pest management philosophies of entomologists like Dr. Lloyd Dosdall, Good's work is motivated by a desire to reduce the use of chemicals in agriculture. "Working together with researchers who understand plant/insect interactions, we can provide sources of genetic resistance found in closely related plant materials and then try and integrate them into economically relevant material plant breeders can work with," he explains. He hopes that in relatively few years, varieties containing the new pest-resistant germplasm will be commercially available to prairie growers, reducing their dependence on pesticides.

AARI has funded Good's work on pest resistance in canola for the last nine years. "AARI has been a tremendous asset in that it has supported basic research while ensuring an applied component," he says. "Furthermore, AARI is willing to allow researchers to decide on the importance of a problem and develop a strategy." AARI does not attempt to micro-manage, he notes, and this has allowed him a great deal of flexibility in structuring his projects in the way he believes will garner results most successfully.

While one of the greatest advantages of academic research is flexibility and independence, says Good, one of the greatest disadvantages is a lack of consistency, particularly on long-term projects. "Students come and go and retraining them impedes a lot of researchers' forward momentum. If there's no framework for handling this constant influx of new staff, the ball on the research stops rolling." Given the current demands on researchers, there is little time for them to manage the administrative requirements of constantly bringing new people into the lab and training them.

Part of Good's success as a researcher, he says, is the ability AARI has given him to retain experienced staff, allowing his research to move ahead uninterrupted. "Unlike some funding bodies who are stuck on the idea that there is a constant need to train students and attract new expertise," says Good, "AARI has been good at addressing and supporting the need for retaining those people who are already trained." He adds that the current abundance of older, skilled researchers in the country highlights the need to shift focus away from the popular fixation on attracting newer, younger candidates to the scientific arena. "When you're 45 years of age and have been doing research all your life, you're an asset to a lot of people. And yet, a lot of funders believe that if you're not tenured, there are no other positions available," he says. "At a time when the country is trying to promote the growth of sectors such as agriculture, to let that human resource go is a terrible loss."

In addition to allowing him the ability to keep skilled staff, Good appreciates what he says is AARI's logical, consistent, and science-driven funding framework. Ultimately, he is gratified by the progress AARI's support has helped him to make in the ongoing effort to breed better canola. "If I hadn't had AARI as one of my core backbone sources of funding, we would be a very different lab than we are today," he says.

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> – Dr. Allen Good
> University of Alberta

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Director's Corner

Driving Economic Growth

For too long public concerns and economic interests have been separated on the R&D agenda. Alan Hall, Managing Director of AARI, explains how this is changing, and why.

Alan Hall

Historically, in Canada, R&D has focused largely on the public sector; that is to say we have engaged in research mainly in the interest of gaining new knowledge and without the benefit of an overall strategic direction. But while we have been engaged in "silo" thinking, many of our economic competitors worldwide have been focused on better alignment between public and industry interests. To ensure that our economic future means prosperity for all Albertans, AARI has been intent on using its funding to facilitate agricultural research which will stimulate economic growth. And now, research results are driving industry expansion and efficiency.

Investment must be tied to industry goals. In many instances, public concerns have become barriers to industry development: such things as water quality, odour, and nutrient loading are but a few of the issues facing agriculture which are high on the public agenda. When research in these areas is done in partnership with industry, it is possible to not only define problems, but also to develop ways to overcome them – ways which ultimately result in sustainable industry expansion.

An excellent example of this marriage of public sector and business interests is the Alberta Poultry Research Centre in Edmonton. The seed was planted when 10 researchers sat down with the University of Alberta and devised a plan to raise funds from industry, government, and other stakeholders to foster research into all aspects of poultry production – everything from hatching, to nutrition, production, and product safety. The first step was to identify industry problems; the second step was to identify what research should be done to address these problems. Alberta's Poultry Research Centre now has an international reputation for innovation and excellence, largely because they have been at the forefront of research which is in tune with industry and industry priorities.

It is in this same spirit that AARI and the Alberta Livestock Industry Development Fund (ALIDF) are discussing similar strategies for the dairy and pork sectors. An examination of the needs and wants of consumers will lead to deliberations on research and development activities which would, in turn, result in successfully meeting market demands. The plans which evolve from these deliberations will shape the priorities for funding R&D proposals. Preliminary talks with the beef sector are also underway.

> Two-way communications between researchers and industry is essential to meeting the goals set for agriculture in Alberta: $20 billion in value-added production and $10 billion in primary production by the year 2010.

Of course poultry and other livestock sectors are not the only ones where R&D is driving economic growth – virtually all commodity groups in Alberta are adopting this way of thinking. The activity we see demonstrates how it pays off, both in acquisition of knowledge and economic growth.

Two-way communications between researchers and industry is essential to meeting the goals set for agriculture in Alberta: $20 billion in value-added production and $10 billion in primary production by the year 2010. Investment must be tied to industry goals, and research must be market-driven and focused on eliminating any roadblocks the sectors are facing. At the same time, we want to ensure that our most creative scientists are operating in the best possible environment, i.e. that they have clear goals in the context of larger strategies, support for a collaborative approach, and a rational, transparent funding mechanism.

AARI has provided funding and encouragement to facilitate this approach within agriculture, and we are seeing significant movement in co-investment for public/industry benefit. Our activity is consistent with the mandate of the Alberta Science and Research Authority (ASRA), which was established to maximize the effectiveness of science and research as an integral component to the success of the province in the global economy.

AARI is proud to be a part of the larger plan for a sustainable future in Alberta. With 2010 now not much more than five years away, our vision is focused on those big picture goals.

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The Link is a quarterly newsletter published by the Alberta Agricultural Research Institute (AARI) that communicates with Alberta's agriculture and research communities. Submissions and feedback are welcome.

AARI was established by the Alberta Science and Research Authority Act and funds numerous projects each year that play a significant role in advancing Alberta's position as a global player in the agriculture and food sector. AARI's mission is to enhance the economic contributions of the Alberta agricultural and food industry through support for research and technology transfer, with a strategic emphasis on life sciences.

AARI is also a member of the Alberta Agriculture Funding Consortium. The Funding Consortium is a strategic partnership of agricultural funding groups that was created to provide better funding for research and development in Alberta's agricultural industry. This unified approach provides a one-window application process for researchers, reducing and simplifying the application workload while ensuring proposals are exposed to a maximum number of funders. The Funding Consortium's goal is to ensure that funding decisions and investment made within Alberta's agricultural sector are consistent with the industry's vision for a thriving and innovative future.

Alberta
INNOVATION AND SCIENCE

ASRA
Alberta Science and Research Authority